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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/656,182	09/08/2003	Allen McTeer	M4065.0248/P248-C	8422
24998	7590	11/29/2005	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			LEE, EUGENE	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2815	

DATE MAILED: 11/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. 10/656,182	Applicant(s) MCTEER, ALLEN	
	Examiner Eugene Lee	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 06 September 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 74-80, 82 and 83 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 74-80, 82 and 83 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 December 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |                                                                                                                        |                                                                                         |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                                                       | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____                                                |

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the said copper layer containing a **copper oxide layer** thereon; and a titanium-aluminum-copper nitrogen layer formed over at least an upper surface portion of said copper layer (claim 79) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

FIG. 8 shows a copper oxide layer; however, it does not show the titanium-aluminum-copper-nitrogen layer formed over at least an upper surface portion of said copper layer **and** the copper oxide layer. Also, it appears (see page 12, lines 7-20 of the applicant's specification) that the copper oxide layer is a result of copper and oxygen in the air, and not a native, inherent component of a copper layer having a minimal thickness and being integral with the copper layer as cited on page 2 of the request for reconsideration filed 9/6/05. Otherwise, any mention of a copper layer would include a copper oxide layer, which is not the case.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the

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renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 74 thru 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada et al. 5,565,378 in view of Hsiao et al. 5,985,765. Harada discloses (see, for example, FIG. 1, and FIG. 3) a bonding pad part comprising a first insulating film (dielectric layer) 75, substrate 71, DRAM element (semiconductor device) 73, barrier metal film (barrier layer) 105, bonding pad (copper layer) 89, and buffer coat film (insulating layer) 81. In column 6, lines 54-60, Harada discloses the aluminum alloy film 107, which the bonding pad is made from, may comprise copper, and titanium. Harada does not disclose said copper layer having a thickness of about 500 Angstroms to about 20,000 Angstroms. However, Hsiao discloses (see, for example, FIG. 6) a bonding pad comprising a layer (copper layer) 18B. In column 5, lines 6-7, Hsiao discloses the layer having a thickness between 6000 and 10000 Angstroms (500 Angstroms to about 20,000 Angstroms). The thickness provides adequate thickness for applying an external

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connection to a bonding pad. Therefore, it would have been obvious one of ordinary skill in the art at the time of invention to have said copper layer having a thickness of about 500 Angstroms to about 20,000 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of the bonding pad in order to have an adequate surface so that a reliable external connection can be made to the bonding pad. See *In re Aller*, 105 USPQ 233.

Regarding claim 75, Harada in view of Hsiao does not disclose said upper surface of said copper layer implanted with titanium having a thickness of about 50 Angstroms to about 200 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of said upper surface of copper layer implanted with titanium in order to adequately add titanium to the bonding pad, which enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said upper surface of said copper layer implanted with titanium having a thickness of about 50 Angstroms to about 200 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of said upper surface of said copper layer implanted with titanium in order to add titanium to the bonding pad for enhancing the resistance to electromigration. See *In re Aller*, 105 USPQ 233.

Regarding claim 76, see, for example, FIG. 1 wherein Harada discloses a surface protecting film (passivation layer) 79. In column 6, line 65, Harada discloses the surface protecting film comprising silicon oxide.

Regarding claim 77, see, for example, FIG. 5 wherein Harada discloses an opening (via) 115 exposing a main surface (portion) 111 of a bonding pad 89.

Regarding claim 78, see, for example, column 6, lines 44-46, wherein Harada discloses the first insulating film 75 comprising silicon oxide.

4. Claims 79, 80, 82, and 83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang et al. 6,423,625 B1 in view of Harada et al. 5,565,378 in view of Mahulikar et al. 5,320,689. Jang discloses (see, for example, FIG. 10) an interconnect structure comprising a copper bonding pad (conductive bond pad) 82, and an AlCu layer 102. In column 3, lines 42-45, Jang discloses the pad has a thin Cu oxide layer. Jang does not disclose the titanium of the titanium-aluminum-copper nitrogen layer. However, Harada discloses (see, for example, column 6, lines 54-61) an aluminum alloy film, which may have titanium added. The metal element enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the titanium of the titanium-aluminum-copper nitrogen layer in order to enhance the resistance to electromigration.

Jang in view of Harada does not disclose nitrogen of the titanium-aluminum-copper nitrogen layer. However, Mahulikar discloses (see, for example, abstract) a composite copper alloy wherein the copper alloy is formed with nitrogen. The copper alloy has improved tribological and mechanical properties while maintaining useful electrical conductivity. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the nitrogen of the titanium-aluminum-copper nitrogen layer in order to improve tribological and mechanical properties while maintaining useful electrical conductivity.

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Regarding claim 82, Jang in view of Harada in view of Mahulikar does not disclose said copper oxide layer having a thickness not greater than 300 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of a copper oxide layer in order to adequately protect an underlying layer. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said copper oxide layer having a thickness not greater than 300 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of a copper layer in order to adequately protect an underlying layer. See *In re Aller*, 105 USPQ 233.

Regarding claim 83, see, for example, column 3, lines 49-57 wherein Jang discloses an Au/Al ball (electrical conductor).

### ***Response to Arguments***

5. Applicant's arguments filed 9/6/05 have been fully considered but they are not persuasive.

Regarding the applicant's argument on page 4, second paragraph that Harada and Hsiao, whether considered alone or in combination, does not disclose, teach or suggest all limitations of claims 74-78, and Harada fails to disclose, teach or suggest "a copper layer formed over said barrier layer," much less "a copper layer formed over said barrier layer, said copper layer having an upper surface implanted with titanium," as independent claim 74 recites, this argument is not persuasive. In column 6, lines 54-60, Harada discloses the film (copper layer) 107 comprising copper, therefore, such a layer is a "copper layer" which is over the barrier layer 105, even

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though it is not exclusively copper. Harada further cites that the film may also comprise titanium.

Regarding the applicant's argument on page 5, first paragraph that Hsiao also fails to disclose, teach or suggest all limitations of claims 74-78, this argument is not persuasive. Applicant further argues in the second paragraph of page 5 that a person of ordinary skill in the art would not have been motivated to combine Harada with Hsiao to arrive at the claimed invention, this argument is not persuasive. In response, the Examiner recognizes that references can not be arbitrarily combined and that there must be some reason why one skilled in the art would be motivated to make the proposed combination of primary and secondary references. In *re Nomiya*, 184 USPQ 607 (CCPA 1975). However, there is no requirement that a motivation to make the modification be expressly articulated. The test for combining references is what the combination of disclosures take as a whole would suggest to one of ordinary skill in the art. In *re McLaughlin*, 170 USPQ 209 (CCPA 1971) references are evaluated by what they suggest to one versed in the art, rather than by their specific disclosures. In *re Bozek*, 163 USPQ 545 (CCPA 1969). In this case, the references deal with two bonding pads wherein Harada does not disclose a thickness. However, Hsiao discloses a bonding pad of a same material but further discloses a thickness. Therefore, since both references deal with the same semiconductor art, and more especially bonding pads, it would have been obvious to one of ordinary skill in the art to combine such references. The proposed combination does not produce a new compound as stated by the applicant on page 5, line 25 but only discloses that a bonding pad can have a specified thickness.



Regarding the applicant's argument on page 6 that Harada discloses a passive state film, and Hsiao discloses a capping layer, these structures are not pertinent to the combination of Harada in view of Hsiao. These structures are external to the bonding pad structure, and do not affect the structure of the bonding pads in Harada and Hsiao, and whether the bonding pad has a specified thickness.

Regarding applicant's argument on page 7, fifth paragraph that neither Jang nor Mahulikar considered alone or in combination, discloses, teaches or suggests all limitations of independent claim 79, this argument is not persuasive. Claims 79, 80, 82, and 83 are unpatentable over Jang in view of Harada in view of Mahulikar, not Jang in view of Mahulikar. Further, applicant argues that Jang teaches "Al or AlCu layer as a glue and protection layer for successful Au wiring" and not "a conductive bond pad containing a copper layer, said copper layer containing a copper oxide layer thereon", this argument is not persuasive. Jang clearly discloses (see, for example, FIG. 10) a copper bonding pad 82 underneath an AlCu layer 102. Mahulikar teaches that copper alloy formed with nitrogen will improve tribological and mechanical properties. Since Jang in view of Harada discloses a copper alloy in the copper bonding pad, it would have been obvious to have nitrogen in the bonding pad in order to improve tribological and mechanical properties.

Regarding applicant's argument on page 8, second paragraph that a person of ordinary skill in the art would not have been motivated to combine these disparate references, this argument is not persuasive. Jang and Mahulikar are not disparate references. Mahulikar states that the material of a copper alloy may be improved by forming with nitrogen. The improvements would clearly be beneficial to the material of the copper bonding pad of Jang.

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Therefore, one of ordinary skill in the art at the time of invention would have been motivated to combine Jang in view of Harada in view of Mahulikar for the above cited reasons.

### ***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

### **INFORMATION ON HOW TO CONTACT THE USPTO**

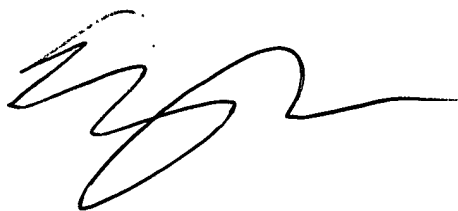
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733. The examiner can normally be reached on M-F 8-5.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 571-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Eugene Lee  
November 15, 2005

A handwritten signature in black ink, appearing to be 'Eugene Lee', written in a cursive style.